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Physics Flash

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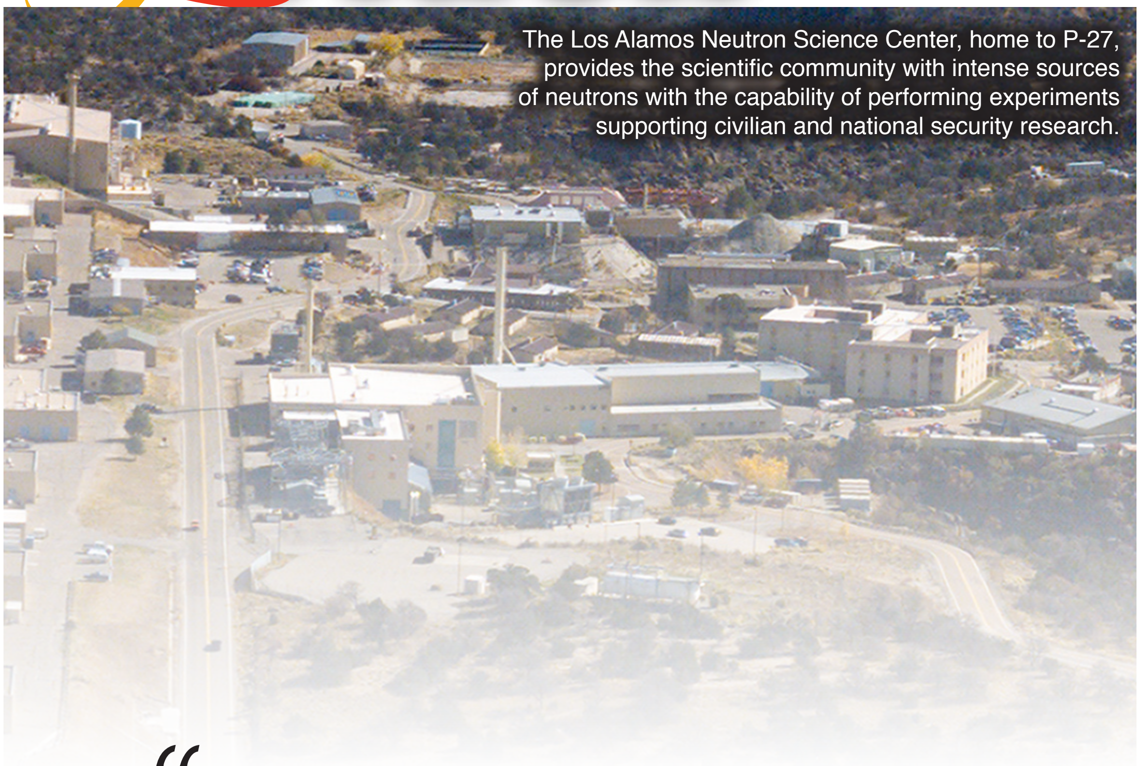
Heads UP!

Celebrating service

Los Alamos NATIONAL LABORATORY EST. 1943



The Los Alamos Neutron Science Center, home to P-27, provides the scientific community with intense sources of neutrons with the capability of performing experiments supporting civilian and national security research.

> ***"P-27 will deliver on a robust and enduring neutron science program with operational excellence."***
>
> *Associate Director Experimental Physical Sciences Mary Hockaday*

Introducing P-27

Combining proven expertise in nuclear physics, materials science, and operational excellence

By Diana Del Mauro, ADEPS Communications

LANSCE Weapons Physics (P-27) is the newest group to join Physics Division, a Los Alamos National Laboratory science and technology organization with a history dating to the Manhattan Project. Launched this month, P-27 reunites within Physics all of the Directorate's experimental nuclear physics research. "The new organizational structure will enable a closer collaboration of the researchers with a common set of technical and scientific expertise within Neutron Science & Technology (P-23), Subatomic Physics (P-25), and P-27 that will enable us to go after new projects and strengthen nuclear physics research at LANL," Physics Division Leader Doug Fulton said.

The Los Alamos Neutron Science Center (LANSCE), with its designated national user facilities, continues to provide important technical capability to the Lab and to the nation and remains a bridge to MaRIE, the Laboratory's proposed experimental facility for Matter-Radiation Interactions in Extremes, according to Associate Director Experimental Physical Sciences Mary Hockaday.

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From Scott's desk . . .

The national nuclear weapons program is changing, and this presents new opportunities for Physics Division to contribute to this vital component of U.S. national security. The Stockpile Stewardship Program (SSP), begun in the early 1990s, is now mature and successful. DOE is starting to think about what SSP 2.0 will look like. The stockpile is now the oldest it has ever been, and will continue to increase in average age for some time to come. The generation of nuclear weapons designers that participated in nuclear testing is rapidly being replaced by a new generation that has only seen simulations and non-nuclear experiments. We have the fastest computers and the best models we have ever had.

I believe there are at least three reasons that science experiments are becoming more relevant to the nuclear weapons program than ever before. First, is the evolution in SSP. Pre-SSP, the actual final product that LANL produced was the confirmatory nuclear tests that validated our designs. Once nuclear testing ended, the product became the computer models that simulated weapon performance. This required enormously more computer power and better models than we had in the past, and the first decade or so of SSP focused on closing this capability gap. Now, a more balanced approach is emerging toward maintaining and improving the ecosystem that is needed to carry out SSP. The computer models remain our product, but to produce them we bring together nuclear weapons designers, experimentalists, theorists, and computer scientists.

Second, our methods for training new nuclear weapons designers is evolving. Pre-SSP, designers learned their craft by designing and executing nuclear tests underground in Nevada. In the early days of SSP, they learned from senior designers with nuclear test experience and from the legacy data of the testing era. With the last test more than 20 years ago, those methods are becoming unsustainable. One of the new approaches that Weapons Physics Directorate is taking is to encourage developing designers to participate in the design, modeling, and analysis of small-scale experiments.

Third, understanding uncertainties in our models of the nation's nuclear weapons is becoming more important with time. I believe that we experimentalists have a unique contribution to make in this area, because of our experience in evaluating the uncertainties in our experiments, particularly those that arise from systematic effects.

I believe there is an expanding opportunity for Physics Division to participate in maintaining the reliability and safety of our nation's nuclear deterrence. We can contribute by performing crucial experiments that validate computer models, or that explore physical phenomena not yet accurately represented by the models. We can invent new experimental capabilities that allow us to maintain our confidence in the efficacy of SSP even as the nuclear testing era recedes further into the past. We can help in the training of new weapons designers and act as trusted advisers to the nuclear weapons program on experimental and related issues. More interaction between Physics Division and Weapons Physics, bringing together the scientists who understand our experimental capabilities with the scientists who understand the needs of the weapons program, will also help us to select the most relevant experiments and ensure that the data actually improves the models.

"*I believe there is an expanding opportunity for Physics Division to participate in maintaining the reliability and safety of our nation's nuclear deterrence.*"

Scott

Acting Physics Division Leader Scott Wilburn

P-27 cont.

P-27 combines nuclear and materials science expertise from the Lujan Neutron Scattering Center and Neutron and Nuclear Science, technical groups previously comprising a scientific division at LANSCE. As well, some LANSCE materials scientists have joined colleagues in the Lab's two main materials organizations, Materials Science and Technology and Materials Physics and Applications divisions, with a team leader providing coordination between the organizations.

P-27's name refers in part to its main sponsor the Nuclear Weapons Program. The group's focus of delivering highly desired experimental data for the weapons program, industry, academia, and Los Alamos's Laboratory-Directed Research and Development program, which remain key sources of funding, aligns with Physics Division's national security and fundamental science missions.

With the formation of P-27, operations of the Weapons Neutron Research Facility, Lujan Center, the Ultracold Neutron Source, and the Proton Radiography Facility are now all stewarded within Physics Division, resulting in cost-effective operational excellence.

For the hundreds of scientists set to use LANSCE neutron beams for nuclear and neutron scattering experiments this fall, P-27 staff will be on hand to ensure the smooth completion—from start-up to data analysis—of research being performed at the Weapons Neutron Research Facility and Lujan Center.

"Data is the chief product that the Experimental Physical Sciences Directorate provides to our sponsors, and some of our programs are critically dependent on the neutron science data that we can provide. P-27 will be indispensable in the delivery of those data," Hockaday said. "P-27 will deliver on a robust and enduring neutron science program with operational excellence. P-27 is poised to make continued, important contributions to national security, industry, and science."

What new opportunities are created by P-27's formation?
"Depending on strategic priorities, new efforts could include expanding the nuclear physics mission with a new dedicated target or the materials science mission focused on additive manufacturing. It was encouraging to hear NNSA Deputy Administrator for Defense Programs Don Cook express interest in additive manufacturing during his recent visit."
Mark Bourke, P-27 acting group leader

Mark Bourke

"It creates tighter collaboration between teams greatly benefitting from shared expertise. Physics Division has extensive expertise in developing diagnostics and detector technologies that could successfully impact the development of a 'materials in extremes' diagnostic capability at LANSCE. Members of P-27 bring expertise linked to materials science and nuclear physics that can be applied to a variety of new detector technologies for in situ diagnostics using x-rays and neutrons."
Anna Llobet, P-27 acting deputy group leader

Anna Llobet

What opportunities at LANSCE are on the horizon for its industrial users?
With integrated circuit characteristics moving towards lower voltages and smaller feature sizes, the concern about neutron-induced failures continues to increase within the semiconductor device community. We are working with our industry users to upgrade our semiconductor testing capabilities with improved neutron monitoring, increased beam spot size, and neutron attenuation diagnostics.
Steve Wender, P-27 advisor for program development

Steve Wender

What roles do Physics Division and LANSCE play in supporting the Science Campaigns?
P-27 will be critical in our achieving both near- and long-term objectives in weapons-related nuclear data for the Science Campaigns. As the group at Los Alamos that will apply world-class talent and expertise in experimental neutron/nuclear physics to weapons data needs, P-27 will spearhead our efforts to deliver nuclear physics data that are critical to Stockpile Stewardship. Using both the fast and moderated neutron flight paths at LANSCE, P-27 will be at the center of critical initiatives such as Chi-Nu (fission neutron spectrum), the Time-Projection Chamber (fission cross-section), DANCE (neutron capture), SPIDER (fission fragment mass yields) and several others. These are core elements of the Stewardship program at Los Alamos that will be used to reduce uncertainties in our assessments of the nuclear weapons stockpile and to understand global nuclear threats.
Steve Sterbenz, Campaign 1 program manager

Steve Sterbenz

How does P-27 support the role of LANSCE as a bridge to a new experimental facility called MaRIE?
The experimental capabilities enabled by the P-27 group will continue to grow and serve a user base across the NNSA complex. This is very important for a future MaRIE facility, in addition to providing important infrastructure for materials research utilizing neutrons."
Cris Barnes, MaRIE capture manager

Cris Barnes

Unlocking the origin and history of meteorites

Preliminary study shows possibilities for nondestructive compositional tomography

Few fragments survived from the mammoth meteor that exploded in a ~440-kiloton bolide event over Chelyabinsk, Russia in 2013, but two samples recently made their way to the Los Alamos Neutron Science Center (LANSCE), where Laboratory researchers used a novel compositional tomography technique to characterize them.

Employing LANSCE's combination of proton and neutron radiography as well as neutron diffraction tools, they hope to extract deeper insights into the meteorite's physical structure, chemical composition, and microstructure without making a single slice—a conventional approach that, unfortunately, destroys valuable details.

The Los Alamos researchers' method aims to preserve spatial relationships of components while also providing three-dimensional compositional information. The distribution of elements, the minerals present in the fragments, as well as their microstructure (preferred orientation, defects, grain sizes, etc.), all aid in interpreting the meteorite's origin and history. The Chelyabinsk meteorite is a low iron, low metals chondrite, meaning it holds secrets about the early solar system.

Although an alternative tomographic technique has been demonstrated by curator Denton Ebel and colleagues at New York's American Museum of Natural History, using synchrotron radiation from the Advanced Photon Source at Argonne National Laboratory, Los Alamos's combined technique of neutron and proton radiography has potential advantages of inferring some compositional information from resonance absorption of neutrons and possibly the ability to examine larger samples.

The samples (Figure 1) were collected by Mark Boslough (Sandia National Laboratories), who provided them to the University of New Mexico's Institute of Meteoritics (IOM) for curation. Rhian Jones (IOM) in turn loaned the samples to Los Alamos for these and related studies, given the Laboratory's expertise, tools, and user-inspired science reputation.

Characterizing the samples called upon the expertise of LANSCE scientists who employed a range of LANSCE probes. To study fragments the size of playing die, the team performed neutron crystallography using the HIPPO (for high-pressure/preferred orientation) instrument; tomographic proton radiography; and neutron time-of-flight radiography.

Using the Lujan Center's neutron time-of-flight spectroscopic radiography tools, the team analyzed a Chelyabinsk fragment and two pieces of Australia's 1969 Murchison meteorite. Neutron diffraction adds the ability to confirm mineral composition and potential preferred orientation or texture, although without spatial resolution. Texture is of interest

Figure 1: By developing more precise ways to examine the internal structure of meteorites, such as this fragment from the startling Chelyabinsk event, Los Alamos researchers and collaborators hope to mine details that could be used to help mitigate the damage of future meteorite explosions on Earth.

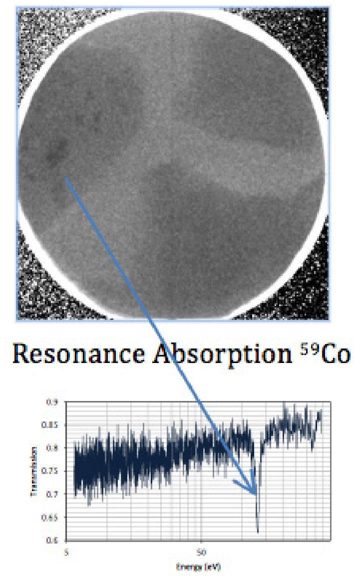

Figure 2: At least one specific mineral phase can be preliminarily identified as kamacite through neutron absorption of ^{59}Co.

because its characterization might enable detection of localized melt or deformation textures from collisional shock events.

At least one specific mineral phase was preliminarily identified as kamacite through neutron absorption of ^{59}Co (Figure 2). This identification of specific isotopes through neutron absorption provides hope of extending tomography measurements to compositional tomography; identification of specific mineral phases may provide internal density standards, which would improve the quality of information on tomographic reconstruction.

The Proton Radiography Facility was used to make 721 images of the Chelyabinsk meteorite sample, resulting in a 360-degree radiographic view of the sample. Individual constituent grains and fissures are readily identifiable as the image rotates. Los Alamos invented proton radiography, and LANSCE has hosted a pRad user facility since 2003. (Please see lansce.lanl.gov/prad/movies.shtml).

The largest fireball to strike Earth in 100 years, the Chelyabinsk blast was similar in energy to a nuclear bomb. Shock waves destroyed buildings, while flying glass and intense ultraviolet rays injured more than 1,000 people. The meteorite was ejected from its parent body in a previous collision in space, and it wandered in orbit until colliding with Earth. Understanding the structure of these bolide-event meteorites will be useful in developing effective mitigation strategies for deflecting inevitable, much larger meteoroids that could otherwise result in mass extinction events. The team hopes to continue investigations on these and similar meteoritic or

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Meteorites cont.

geologic samples to develop the concept and applications of compositional tomography.

LDRD reserve funding (LDRD 20130811ER) funded the preliminary work, which supports the Lab's Global Security mission area and the Science of Signatures pillar. Researchers include Chad Olinger (Applied Modern Physics, P-21); Andy Saunders and Chris Morris (Subatomic Physics, P-25); Sven Vogel (Lujan Center, LANSCE-LC); Rhian Jones (University of New Mexico); and A. Tremsin (University of California, Berkeley).

Technical contact: Chad Olinger

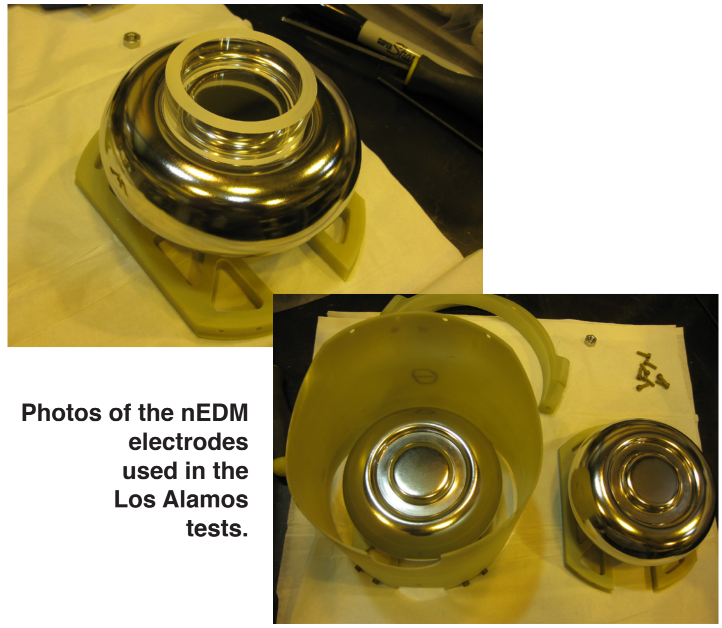
R&D innovations for the neutron electric dipole moment experiment

Expanding knowledge of fundamental neutron physics

If proven to exist, the neutron electric dipole moment (nEDM) could provide insight into why the universe is made almost completely of matter instead of antimatter. Neutrons cooled slightly above absolute zero with superfluid helium are central to an ambitious new nEDM experiment at Oak Ridge National Laboratory's Spallation Neutron Source (SNS), which is in the R&D stage and not yet producing data. This multi-institutional project will search for a tiny separation of positive and negative charges inside the neutron. Principal Investigator Takeyasu Ito, Steve Clayton, John Ramsey, and Scott Currie (Subatomic Physics, P-25) and external collaborators report technical innovations that could help push the nEDM experimental limit to a sensitivity below 5×10^{-28} e-cm as a signature of charge-parity (CP) violation.

The highest priority R&D task is to establish the strength of the electric field, which must be applied stably in the region inside the measurement cells filled with superfluid helium. To study the electric breakdown in liquid helium, the team constructed the medium scale high voltage test apparatus to accommodate electrodes 12 cm in diameter in a 6-liter liquid helium volume that can be cooled to 0.4 Kelvin and whose pressure can be varied between the saturated vapor pressure (10^{-6} torr at 0.4 Kelvin) and atmospheric pressure.

The team demonstrated that an 80 kV/cm electric field could be applied stably in a 1-cm gap between electro-polished stainless steel electrodes with a dielectric insulator inserted between two electrodes. Researchers immersed the insulator in liquid helium at 0.4 Kelvin. Performance of the high voltage leads limited the achievable field, and the scientists did not observe electric breakdown in the electrode gap. (Previously, they demonstrated that electric fields exceeding 100 kV/cm can be applied stably in a 1-cm gap between electro-polished stainless steel electrodes without a dielectric insulator inserted between two electrodes.) For the nEDM detector, the team designed a superconducting quantum interference (SQUID)-based readout system to detect



Photos of the nEDM electrodes used in the Los Alamos tests.

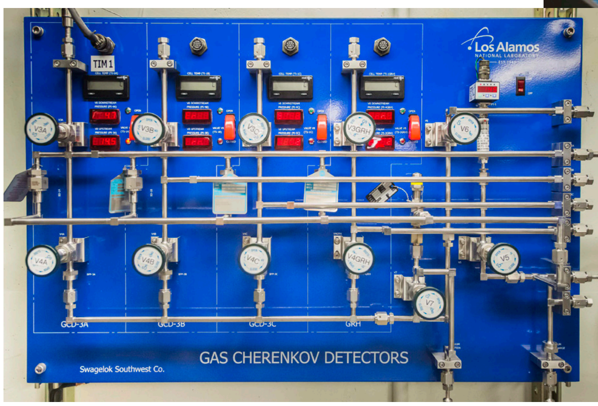
the precession of polarized helium-3 in the measurement cell directly. The SQUID system achieved the needed signal to noise ratio. Because helium-3 occupies the same volume as the ultracold neutrons do, measuring its precession frequency provides a measurement of the magnetic field averaged over exactly the relevant volume. This enables a correction for changes in the magnetic field experienced by the neutrons, effectively cancelling an otherwise overwhelming systematic effect.

Early work by Applied Modern Physics (P-21) showed that SQUIDs could, in principle, be used to detect the very small (several-femtotesla) magnetization signal from helium-3 for the nEDM experiment. P-25 subsequently demonstrated that a SQUID-based system could be accommodated into the planned nEDM apparatus, which requires very long leads between a pickup loop mounted on the cell to the SQUID itself, with a sufficient signal-to-noise ratio. The team also reported that a photomultiplier tube (PMT), a device that cannot be turned off during the measurement period, does not significantly increase the noise floor of the SQUID measurement when the PMT is powered by a custom, battery-powered high-voltage supply. The researchers demonstrated that reference magnetometers mounted near the gradiometric pickup loops can be used to sharply reduce unwanted, vibration-induced signals from the magnetization measurement. This modification relaxes an otherwise difficult engineering requirement to stiffen the supports holding the 0.4-Kelvin nEDM central volume within a 4-Kelvin magnet package.

Los Alamos National Laboratory is 1 of 19 institutions in the nEDM at the Spallation Neutron Source collaboration. The DOE Office of Science, Office of Nuclear Physics funded the work performed at Los Alamos, which supports the Lab's Nuclear and Particle Futures science pillar.

Technical contact: Takeyasu Ito

GCD-3 pressure vessel prior to insertion in an OMEGA TIM.



Gas panel manifold (left) mounted in LaCave to enable remote pressurization of the detector and the Gamma Ray History system. The new gas detector is capable of being pressurized to 400 psia, providing Cherenkov thresholds as low as 1.8 MeV. The vessel is approximately 1 meter long.

Photos courtesy of Eugene Kowaluk, University of Rochester.

New gamma-detection instrument yields better fusion energy measurements

Plasma Physics (P-24) staff designed, engineered, and fabricated core parts of the newest gas Cherenkov detector (GCD-3), which records gamma reaction history measurements during inertial confinement fusion implosions—important details for understanding the fusion process.

Successfully fielded on the Omega laser at the University of Rochester in New York, the detector was recently operated at 400 psia of CO_2 (3 MeV threshold) to measure the 5.5-MeV gamma rays resulting from p+D fusion as part of the nuclear-astro physics collaboration with the Massachusetts Institute of Technology.

The Cherenkov response appears consistent with computer simulation predictions using Monte Carlo methods in the (Geant4) GEometry And Tracking platform (Mike Rubery, Atomic Weapons Establishment). This indicates the instrument has the higher-sensitivity, lower-energy-threshold gamma ray detection expected, opening up a new window on inertial confinement fusion (ICF) gamma ray spectroscopy.

The heart of the new detector system, also known as the "SUPER GCD," is an American Society of Mechanical Engineers (ASME) code-stamped pressure vessel designed by the P-24 Diagnostic and Systems Engineering Team and fabricated and tested per the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 by Meyer Tool & Manufacturing Inc. in Oak Lawn, Illinois.

The internal light collection components mimic the design of a Cassegrain telescope, yet have been optimized by P-24's years of experience fielding previous Cherenkov detectors. The system also consists of a pressure distribution system capable of supplying pressure to four detector systems and one Gamma Reaction History system simultaneously. The LaCave manifold panel and target bay portable manifolds were also designed by the P-24 team and SwageLok Southwest of Albuquerque, New Mexico.

For the Omega laser experiments, the detector acquired amazing high density (HD) fusion gamma signals, backed up by control implosions of D_2 & H_2, and simultaneous detector measurements at 6.3 MeV threshold to prove that the scientists are indeed seeing 5.5 MeV HD gammas. Alex Zylstra (MIT), the principal investigator for these experiments, obtained excellent quality data to support the Stellar and Big Bang Nucleosynthesis portion of his Ph.D. thesis.

Further qualifications will be required to allow operation with C_2F_6, which will enable thresholds down to approximately 1.8 MeV. An investigation of ^{13}C(n,n'g) vs ^{12}C(n,n'g) using carbon-powder-pucks near deuterium-tritium implosions will be conducted at that time as a feasibility study for possible "dark mix" studies at the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory. These new results bode well for those experiments.

The newest gas Cherenkov detector has been a two-year project led by principal investigator Hans Herrmann and project manager John Oertel. The P-24 Diagnostic and Systems Engineering Team consisted of electrical/mechani-

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Instrument cont.

cal technicians Tom Archuleta, Robert Aragonez and Tom Sedillo, mechanical design engineer Valerie Fatherley, electrical engineer Albert Hsu, and pressure safety officer/mechanical engineering supervisor Frank Lopez. The project was developed under LANL's Inertial Confinement Fusion program (Campaign 10 Program Manager Steve Batha) and supports High Energy Density Physics and Fluid Dynamics (HEDPF) within the Nuclear and Particle Futures (NPF) Science Pillar in addition to the Science of Signatures pillar.

Technical contact: Hans Herrmann

In memoriam

Dick Wakefield passed away recently after a long career in J Division and then P Division. He was 83. He provided strong leadership as a deputy group leader in helping to guide many of the P-15 diagnostic tools and experiments for the underground nuclear testing effort in Nevada. In addition, his providing management guidance to EG&G, Bechtel Nevada, and more recently NSTec resulted in optimized support for the P-15 experimental effort as well as the coordination with available LANL resources. Some of the most sophisiticated and high-precision experiments were the result. He continued to contribute to the LANL underground testing effort through organization of our data archiving program. He will be missed.

Nick King (Neutron Science and Technology, P-23)

Majorana Demonstrator milestones reached

Los Alamos team designs, builds 60-ton lead shield, system for calibrating cryostat for international neutrino experiment

The Majorana Demonstrator (MJD) located 4850' underground in the Sanford Underground Research Facility in Lead, South Dakota, has recently reached several major milestones.

The MJD experiment will use an array of germanium detectors to study neutrinoless double beta decay of the nucleus in ^{76}Ge. Observation of this process would provide valuable clues to why the universe is made of matter instead of antimatter and determine the mass of the neutrino. So far the process has not been observed. Neutrinos are fundamental particles that play key roles in the early universe, cosmology, astrophysics, and nuclear and particle physics.

In March, the final lead brick was installed in the passive shield that will reduce the neutron background for the experiment (Figure 1). The shield building effort was a major contribution of the LANL team led by Steve Elliott and included Wenqin Xu, John Goett, Larry Rodriguez and Keith Rielage (all Neutron Science and Technology, P-23). The shield was designed by Harry Salazar (Mechanical Design Engineering, AOT-MDE). The main shield is composed of more than 5,500 lead bricks with a total weight of over 60 tons—more than a Boeing 737! In June, the prototype cryostat containing the first 10 Ge detectors was moved into the shield (Figures 2 and 3). These detectors are now taking data in the shield to study backgrounds and are being calibrated with a system designed and built at LANL. A full complement of detectors (30 kg of detectors fabricated from Ge enriched in the isotope 76) is being assembled and installed in the next cryostat to start the neutrinoless double beta decay measurements later this year.

The experiment is being constructed by a collaboration of approximately 100 scientists from 18 institutions from four

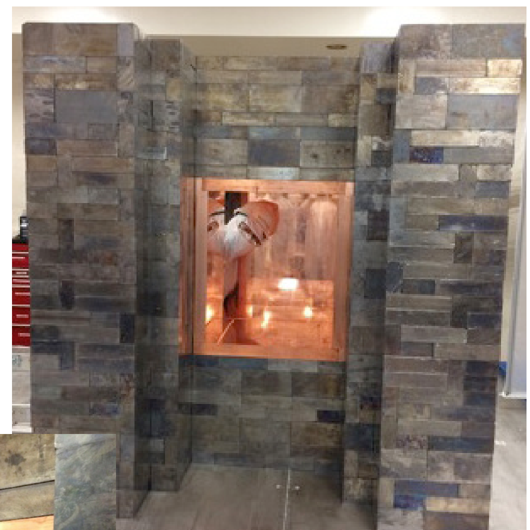

Figure 1: Completed lead shield for the MJD experiment. Vince Guiseppe of the University of South Carolina (and former LANL postdoc) can be seen in the center of the shield lined with copper.

Figure 2: MJD prototype cryostat being inserted into shield.

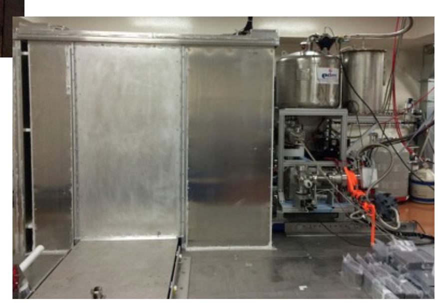

Figure 3: The MJD prototype cryostat assembly (on right) inserted into shield. The lead/copper shield is now enclosed in a radon box to keep radon out of the experiment and covered by several veto panels to reject external background events.

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Majorana cont.

countries. Elliott is the spokesperson for the collaboration. The experiment is supported at LANL by the DOE Office of Science Nuclear Physics Program. The work is part of the Laboratory's Beyond the Standard Model Grand Challenge and supports the Nuclear and Particle Futures science pillar.

Technical contact: Steve Elliott

Members of the Nuclear Program Advisory Committee listen to a presentation in the Nuclear Technology subcommittee.

Robust range of nuclear physics research proposed for 2014 WNR beam time

In preparation for the 2014 Weapons Neutron Research facility (WNR) run cycle currently underway, the Nuclear Program Advisory Committee (NPAC) met at the Los Alamos Neutron Science Center (LANSCE) this summer to review the nonproprietary beam time proposals submitted to WNR.

WNR received more than 60 proposals during the open call between April 8-June 2. In addition, there were 16 proprietary proposals, which were submitted by users who pay for beam time but were not reviewed. This large number demonstrates the demand, interest, and value that WNR provides to the nuclear physics community. There were more than 550 user visits to the LANSCE nuclear science facilities during the past run cycle.

The purpose of the NPAC is to ensure the scientific quality of the Nuclear Science User Program conducted at WNR. The separate sub-committees of NPAC include Basic Nuclear and Particle Physics, Nuclear Technology, and Defense-Related Nuclear Science. The WNR welcomed reviewers serving on the NPAC from LANL, Lawrence Livermore National Laboratory, Rutgers University, North Carolina State University, Michigan State University, and Westmont College. Principal investigators presented beam time proposals in brief, public presentations followed by questions and discussions by the committee. The proposals spanned a broad range of topics including cross section measurements, radiography and tomography, nuclear fuels, detector and instrumentation development, radiation effects on electronics and materials and other neutron-induced reactions. The NPAC scored each experiment according to scientific merit and/or programmatic or technological impact, technical feasibility, and quality of the scientific team and suitability of the available resources.
Technical contact: Stephen Wender

HeadsUP!

Laboratory earns VPP Star status

The Laboratory has attained Voluntary Protection Program Star level recognition from the DOE, the largest site in the DOE complex to do so. VPP Star level recognition means LANL has and continues to implement excellent safety programs that systemically protect employees. It is based on an assessment of management commitment, employee involvement, worksite analysis, hazard prevention and control and safety and health training.

Achieving VPP Star Status follows the Lab attaining VPP Merit level recognition in 2010. At the time, then Director Michael Anastasio committed LANL to pursuing VPP Star Status. During the most recent VPP assessment last spring, DOE assessors focused on the Los Alamos Neutron Science Center at TA-53 and technical areas 54 and 55. Workers and managers were encouraged to participate in the assessment.

Celebrating service

Congratulations to the following Physics Division employees celebrating service anniversaries recently:

Thomas Archuleta, P-24.....................................25 years
Charles Peterson, P-21......................................25 years
Jeanette Gray, P-DO.............. ....20 years
Sasikumar Palaniyappan, P-24............................5 years

PhysicsFlash

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To submit news items or for more information, contact Karen Kippen, ADEPS Communications, at 505-606-1822, or kkippen@lanl.gov.

For past issues, see www.lanl.gov/orgs/p/flash_files/flash.shtml